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BUILDING PHYSICS: A CONCEPTUAL SOLUTION OF SICK BUILDING

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Abstract: Building failures related to moisture, ventilation and energy issues could be avoided if there were fewer misunderstandings and more knowledge between the different actors involved in the building process over the importance of building physics. Ignoring building physics principles during the design and construction phases can lead to a number of problems during the operation phase such high energy usage, health problems, physical building damage and a host of other problems related to these. Now a days problem are arise in building is due to the imbalance occur in the environmental condition indoor and outdoor of the building. This paper aims to show the problem arises due to the sick building and the solution to come out of this sick building.
Keywords: **airtightness, heat insulation, moisture transfer, sick building**

I. INTRODUCTION

Building physics is the science of how energy interacts with the materials within a building envelope. It encompasses the fields of heat transfer, moisture transfer and air flows. This means that building physics can include other areas such as energy efficiency, indoor air quality, mould in buildings, ventilation systems etc. Building physics is originates from the three application oriented disciplines: applied physics, building services and building construction. Already in the 20th century, some circle of the physicist showed a lot interest in the application of the noise control to building construction. Building Physics is bound by the necessities of the building, which means the creation of the indoor environment which protect human being against unexpected changes in the climate. As a consequences, the separation between the inside and outside i.e. the envelope of the building (floor, facade, roof) is submitted to the numerous climatology loads and climate differences. An appropriate envelope design along with the appropriate detailing will reduce the effects of external climatology loads. Appropriate building envelope design will minimize the consumption of energy and also improve the indoor environment.

II. SICK BUILDING

Building physics is the science of how energy interacts with the materials within a building envelope. It encompasses the fields of heat transfer, moisture transfer and air flows. This means that building physics can include other areas such as energy efficiency, indoor air quality, mould in buildings, ventilation systems etc. Sick building causes are frequently pinned down to flaws in the heating, ventilation, and air conditioning (HVAC) systems. Other causes have been attributed to contaminants produced by outgassing of some types of building materials, volatile organic compounds (VOC), molds, improper exhaust ventilation of ozone (byproduct of some office machinery), light industrial chemicals used within, or lack of adequate fresh-air intake/air filtration.

III. PROBLEMS ARISES DUE TO THE SICK BUILDING

Problem related to structure

HVAC designers must consider and deal with moisture in almost all of their work. Moisture, from whatever sources, is commonly regarded as the single greatest threat to the durability and long-term performance of the housing stock (Newport Partners Report, 2004). Figure shows some examples of damage to building materials caused by moisture. Failure to properly manage the transport of heat, air and moisture across the wall assembly can cause the following problems:

1. Electrochemical corrosion of metal components such as HVAC equipment, ducts, structural framing, and reinforcement bars, masonry anchors, etc.
2. The chemical deterioration and dissolution of materials such as gypsum sheathing, ceiling tiles, especially wood products on the exterior walls
3. Discoloration of building finishes.
4. Volume changes (swelling, warping and shrinkage) that can cause degradation of appearance, structural failure, cracking, etc.
5. Freeze-thaw deterioration of concrete, stone, and masonry, especially for buildings in cold areas if the building materials contain moisture (e.g., if the concrete holds more than 44% moisture by pore volume, freeze-thaw damage to the concrete block may happen if the temperature drops below the freezing point.
6. The increase of material thermal conductivity due to the moisture within the material.
7. The growth of biological forms, including molds, mildews, mites, etc.

Problem related to human health

1. Respiratory problems, such as wheezing, and difficulty in breathing
2. Nasal and sinus congestion
3. Burning and watering eyes
4. Dry, hacking cough
5. Sore throat
6. Nose and throat irritation
7. Shortness of breath
8. Skin irritation
9. Mood problems

IV. SOLUTION FOR SICK BUILDING

Airtightness

Air tightness or more accurately referred to as convection tightness is an essential parameter of modern and sustainable constructions. The heat- transmitting enfolded area including the joints must be permanently made airtight according to the acknowledged rules of technology. According to OIB Directive 6 “Energy savings and heat insulation”

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1. The building envelope of new constructions must be made permanently airtight and windproof.
2. The air change rate n50, measured at a pressure difference of 50 Pascal between interior and exterior space and determined through negative and positive pressure, with closed openings of outgoing and incoming air, must not exceed a value of 3.0 per hour.
3. If a mechanically operated ventilation system is installed with or without heat recovery the air change rate n50 must not exceed the value of 1.5 per hour.
4. For detached houses, semi- detached houses and terraced houses, this value is required for each house and for multi- family houses it must be reached per living unit.
5. Passive houses require an air change rate of $n50 < 0.6\ h^{-1}$.

In practice, very often no difference is made between these two terms, although there are clear distinctions to be made. Wind tightness of a construction component prevents air flows from entering insulation layers and thus the loss of heat into the open. The wind-proofness of buildings can be compared to the outside material of winter jackets: if the windproof layer is missing, heat will escape and cause a person to feel cold. As wind insulations are always located at the outside of the insulation layers, the vapour diffusion resistance of the wind insulation should be as low as possible, and it should be taken into account in physical construction considerations. The air tightness of a construction component or an entire building is a measurable unit (air change rate).It indicates the amount of air per hour [m^3/h] flowing between the inside and outside of a construction component and/or building at a certain defined pressure difference.

Heat Insulation:

The use of solid wood panels for wall and ceiling structures is of an advantage, because it can be installed in mostly homogenous layers, as opposed to other lightweight construction types. This leads to even temperature fields across the entire surface and is also advantageous for the hygro-thermal behaviour of the construction (safety potential due to the available moisture storage mass of the existing solid wood wall, higher application tolerance) the construction becomes more resilient.

The aim inside buildings during winter is to create temperatures that ensure a high level of comfort.

Moisture transfer and reduction:

Moisture moves under different mechanisms in each of it phases. The primary transport processes, beginning with the least powerful to the most, are:

1. Vapour diffusion within some porous materials;
2. Vapour convection (i.e., air movement);
3. Liquid water capillarity (i.e., wicking) through porous materials;
4. Liquid gravity flow (including hydrostatic pressure) through cracks, openings;

This moisture transfer can be prevented by providing the dry wall or by applying the wood panel on the wall.

SUMMARY

Energy efficiency and environmental protection has received increased attention over the last years. Buildings are important energy consumers and therefore their energy demand receives substantial interest. One of the options is to reduce the transmission losses of the buildings by better insulating the different building components. Another approach is making better use of solar and internal gains. By using this concept it become useful to balance the indoor atmosphere from outside atmosphere. It provides the healthy atmosphere so it's also beneficial for the human health. Structure also not gets suffer from minor deterioration which further leads into the failure.

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